Astronomy: Earth and Space Systems

8-4 The student will demonstrate an understanding of the characteristics, structure, and predictable motions of celestial bodies. (Earth Science)

8.4.8 Explain the difference between mass and weight by using the concept of gravitational force.

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: Students were introduced to the use of a balance for measuring mass (2-1.2, and also in math), and mass as a property of solids and liquids (2-4.1), in 2nd grade. The use of the spring scale was introduced in 6th grade (6-1.1). This concept of the difference between mass and weight, although they are related, is new to this grade. Students may come with a misconception that they are the same since instruction in previous grades has dealt with objects on Earth where there is very little difference noted in the measurement of mass and weight and the standard English units are the same.

It is essential for students to know that the concept of gravitational force can be used to explain the difference between mass and weight.

Mass

- *Mass* is the amount of matter in an object; it does not depend on forces acting on it.
- Mass is the same no matter where the object is located as long as the object does not gain or lose any of its matter.
- An object that has mass can be pulled on by gravitational force.
- Mass is measured on a balance.

Weight

- W*eight* is a measure of the pull of gravity on an object.
- Weight is related to mass but they are not the same.
- Weight on Earth is based on the pull of gravity toward the center of Earth.
- Weight can change on Earth since the pull of gravity is not the same everywhere.
- Weight is measured using a *spring scale*.
- Weight can change if an object is located on another object in space, for example, the Moon or Mars.
- The mass of that larger object determines the pull of gravity and therefore the weight of the object.
- Weight may change due to the change in gravitational force, but mass stays the same.

It is not essential for students to calculate weight differences between an object on Earth and the Moon, or convert mass in kilograms to weight in newtons.

Assessment Guidelines:

The objective of this indicator is to *explain* the difference between mass and weight using the concept of gravitational force; therefore, the primary focus of assessment should be to construct a cause-and-effect model that shows how gravitational force affects mass and weight but makes them different. However, appropriate assessments should also require students to *compare* mass and weight; or *infer* whether an object would be heavier or lighter based on gravitational pull.